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|  | **Unit 1: Biochemistry** | | | | | | | |
| Name: | | Start: | | | 09/20/16 |  |  |  |
|  | | Test 2 Date: | | | 10/17/16 |  |  |  |
| Period: | | Teacher: Ms. J | | | |  |  |  |
|  | |  |  |  |  |  |  |  |
| **Biochemistry Part II** | | Submitted | Resubmit | Correct | Evidence of Learning | Page | Date | Sign-Off |
| **Objective 4:** Explain how DNA and RNA code for proteins and determine traits. | |  |  |  | **DNA Replication Coloring** |  |  |  |
|  |  |  |  |  |
|  |  |  | **Catalyst 1: TBD** |  |  |
|  |  |  | **Notes: Central Dogma** |  |  |
|  |  |  | **HW: Replication and Transcription** |  |  |
|  |  |  | **Catalyst 2: Important Enzymes** |  |  |
|  |  |  | **Online Activity: Protein Synthesis** |  |  |
|  |  |  | **HW: Translation Review** |  |  |
|  |  |  | **Class Activity: Protein Synthesis** |  |  |
|  |  |  | **Worksheet: Protein Synthesis (Graphic)** |  |
|  |  |  | Creative Project: Central Dogma Explanation |  |  |
|  |  |  | Writing: Working in a Protein Factory |  |
|  |  |  | **Quiz: Objective 4** |  |  |

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|  | | Second Position | | | | | | | |  | |
| U | | C | | A | | G | |
| First Position | U | UUU | Phenylalanine (phe) | UCU | Serine  (ser) | UAU | Tyrosine  (tyr) | UGU | Cysteine  (cys) | U | Third Position | |
| UUC | UCC | UAC | UGC | C |
| UUA | Leucine  (leu) | UCA | UAA | *STOP* | UGA | *STOP* | A |
| UUG | UCG | UAG | UGG | Tryptophan (trp) | G |
| C | CUU | Leucine  (leu) | CCU | Proline  (pro) | CAU | Histidine  (his) | CGU | Arginine  (arg) | U |
| CUC | CCC | CAC | CGC | C |
| CUA | CCA | CAA | Glutamine (gln) | CGA | A |
| CUG | CCG | CAG | CGG | G |
| A | AUU | Isoleucine (ile) | ACU | Threonine (thr) | AAU | Asparagine (asn) | AGU | Serine  (ser) | U |
| AUC | ACC | AAC | AGC | C |
| AUA | ACA | AAA | Lysine  (lys) | AGA | Arginine  (arg) | A |
| AUG | Methionine (met) *START* | ACG | AAG | AGG | G |
| G | GUU | Valine  (val) | GCU | Alanine  (ala) | GAU | Aspartic acid (asp) | GGU | Glycine  (gly) | U |
| GUC | GCC | GAC | GGC | C |
| GUA | GCA | GAA | Glutamic acid (glu) | GGA | A |
| GUG | GCG | GAG | GGG | G |

**Unit 1: Biochemistry**

Start Date: 09/20/2016 Test 2 Date: 10/17/2016

**Objective 3:** Explain the double-stranded, complementary nature of DNA as related to its function in the cell.

*Essential Question:* What is the structure of DNA?

*Essential Question:* What is the structure of RNA?

*Essential Question:* How is DNA replicated?

*“I Can” Statements:*

* Identify the double-helix structure of DNA, with sides composed of alternating phosphate-sugar groups and “rungs” composed of complementary nitrogenous base pairs joined by weak hydrogen bonds
* Match DNA base-pair nucleotides (A-T, G-C) appropriately
* Develop a cause-and-effect model relating the structure of DNA to the functions of replication, transcription, and translation (protein synthesis)
* Compare/contrast DNA and RNA
* Explain that the sequence of nucleotides in DNA can code for proteins, but also encodes tRNA and rRNA and some stretches of DNA that appear to have no function.

**Objective 4: Explain how DNA and RNA code for proteins and determine traits.**

***Essential Question:* What are the roles of mRNA, tRNA, and rRNA in the protein synthesis process?**

***“I Can” Statements:***

* **Interpret a codon chart to predict the amino acids coded for by a nucleotide sequence.**
* **Identify the roles of the three types of RNA (tRNA, mRNA, rRNA)**
* **Explain the connection between nucleotide sequence and the resulting protein (Central Dogma: DNA 🡪 mRNA 🡪 protein)**
* **Explain the process of protein synthesis**
  + **Transcription that produces an RNA copy of DNA, which is further modified into the three types of RNA**
  + **mRNA traveling to the ribosome (rRNA)**
  + **Translation – tRNA supplies appropriate amino acids**
  + **Amino acids are linked by peptide bonds to form polypeptides. Polypeptide chains from protein molecules. Proteins can be structural (forming a part of the cell materials) or functional (hormones, enzymes, or chemical involved in cell chemistry).**
* **Explain how an amino acid sequence forms a protein that leads to a particular function and phenotype (trait) in an organism.**
* **Explain how cells can responds to their environments by producing different types and amounts of proteins by changing the expression of genes.**

**Objective 5:** Explain how mutations in DNA that result from interactions with the environment (i.e. radiation and chemicals) or new combinations in existing genes lead to changes in function and phenotype.

*Essential Question:* What happens when mutations occur in DNA?

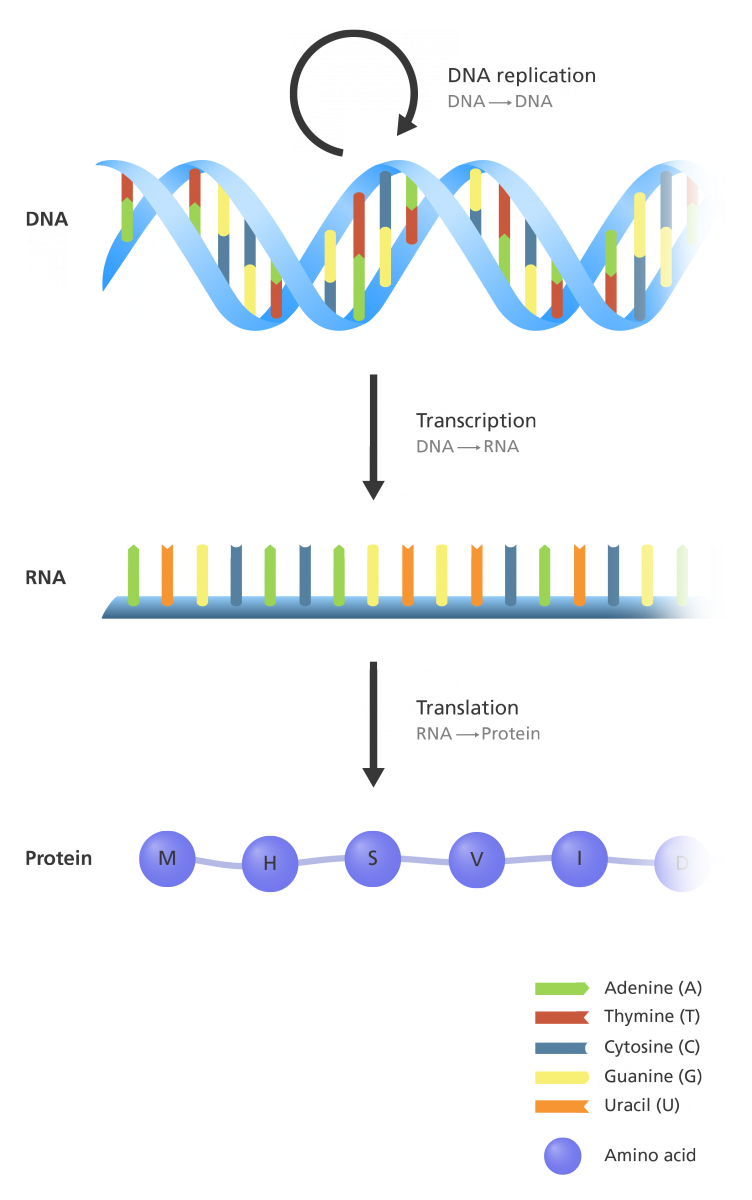
*“I Can” Statements:*

* Model how changes in nucleotide sequence (mutations) can alter the resulting protein
* Infer the advantages (injury repair) an disadvantages (cancer) of the overproduction, under production, or production of proteins at incorrect times
* Develop a cause-and-effect model in order to describe how mutations occur: changing amino acid sequence, protein function, phenotype
* Explain that changes in the DNA sequence (mutations) can be deletions, additions, or substitutions

**CATALYST 1**

**CATALYST 2**

* **Helicase-**
* **DNA Polymerase-**
* **RNA Polymerase-**



Biology

Central Dogma Notes

**Part I: Replication**

* DNA has to be replicated when\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* DNA replication occurs in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_of the cell
* The new molecule of DNA has to be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to the old strand.

Step 1: \_\_\_\_**\_\_\_\_\_\_\_\_\_\_\_\_**unzips and separate the DNA strands by breaking the \_\_\_\_\_\_\_\_\_\_\_\_\_ bonds

Step 2: **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**bases in the nucleus attach to open sites using base pairing rules.

Step 3**. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**attaches the free nucleotides and “proofreads” each new DNA strand. The new strand of DNA is half “old” and half “new” meaning it is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Biology

Central Dogma Notes

**Part II: Transcription**

* DNA cannot leave the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ yet it hold all of the genetic instruction needed by the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to make proteins
* Using DNA as a template, the genetic instructions to a make a protein can be transcribed into \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is the “messenger” that can leave the nucleus and take the instructions to build a protein to the ribosomes

**Step 1 (Initiation)** : The process begins on a specific part of the gene called the \_\_\_\_\_\_\_\_\_\_\_\_ region. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ unzips the double helix by breaking the hydrogen bonds.

**Step 2 (Elongation)** : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ adds free floating **RNA** nucleotides in the 5’ to 3’ direction

\* In this step, \_\_\_\_\_\_\_\_\_\_\_ matches with Adenine, replacing \_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the mRNA sequence

**Step 3 (Termination)**: A sequence on the gene called the \_\_\_\_\_\_\_\_\_\_\_\_\_ region is reached and the DNA polymerase detaches. At this point the mRNA molecule is complete and can leave the nucleus to travel to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Part III: Translation**

The Genetic Code

* A codon is:
* Each codon codes for a specific \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* There are \_\_\_\_\_\_\_\_\_\_\_\_\_\_ codons total, 1 for start (AUG) and 3 for stop.
* An Anti-codon is:
* tRNA is:

**Step 1**: mRNA goes to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ where the code will be translate

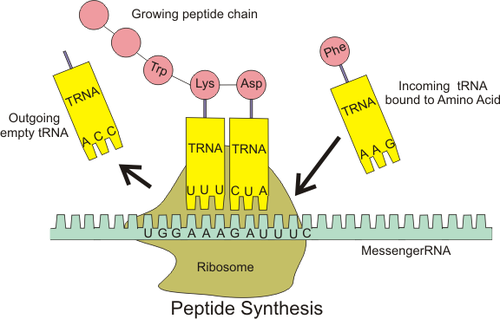
**Step 2**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_codon recognized by anti-codon on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Example: codon – UCA anticodon – AGU

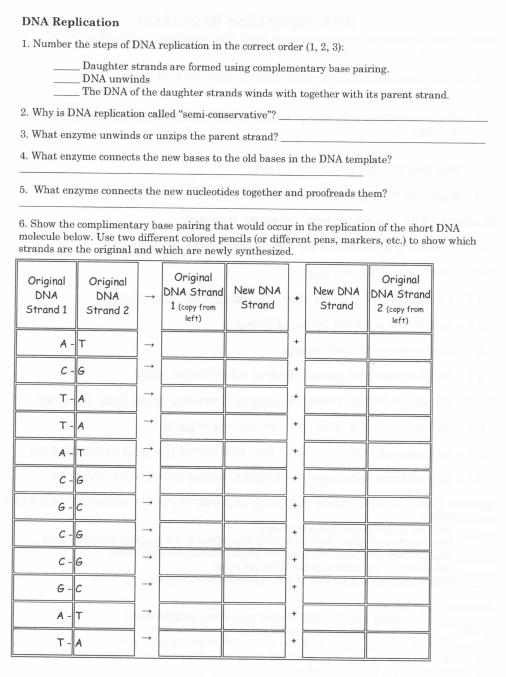
**Step 3**: tRNA brings proper \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_to the codon sequence

**Step 4:** tRNA drops off Amino Acid and chain begins to form, with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bonds connecting the amino acids

**Step 5:** Repeat from step 2 until “stop” codon is reached and newly formed \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is released.



Biology Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Worksheet: Replication and Transcription Period: \_\_\_ Date: \_\_\_/\_\_\_/\_\_\_

DNA TRANSCRIPTION & TRANSLATION WORKSHEET. 1) Each DNA molecule has two sides, one is called the template from which the mRNA is constructed by RNA polymerase, and the other is the coding side which codes for a protein. If the template side of a DNA molecule is the sequence shown below, what will the coding side base sequence be? (Show the proper number of hydrogen bonds connecting the bases) 2) If the template strand from above is used, what will the resulting mRNA molecule base sequence be? Write the base sequence for mRNA above the bases of the DNA molecule. Diagram a RNA nucleotide (197) in the box provided. 3) Using the mRNA codon list (Page 207) for amino acids, determine the amino acid sequence for the mRNA sequence above. \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ 4) If a mutation occurred to the fourth base in the template side, thymine, and a substitution occurred such that a guanine replaced the thymine, would the protein be changed? If so, how? 5) If the substitution occurred to the 6th base on the template side, such that the cytosine was changed to a thymine, would the protein change? Why? 6) Summarize the roles of the following enzymes that play a role in DNA functions? a. Helicase \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ b. DNA polymerase \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ c. RNA polymerase \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 7) Describe the location of each process listed below and what then name the product of each process. a. Transcription \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ b. Translation \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 8) Describe the role of the following base(s) on the DNA molecule. a. Codon \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a. Promoter \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ b. Termination codon \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 9) List the start and stop codons found on RNA. a. Start codon \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ b. Stop codons \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_ 10) If the DNA coding strand is ATGTGTAGTGCGAGTTGA, what would the amino acid sequence be?

Biology Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Worksheet: Protein Synthesis (Graphic) Period: \_\_\_ Date: \_\_\_/\_\_\_/\_\_\_

**Objective 4:** Explain how DNA and RNA code for proteins and determine traits.

**Procedure:**

1. Fill in the complementary DNA strand using DNA base pairing rules.
2. Fill in the correct mRNA bases by transcribing the bottom DNA code.
3. Translate the mRNA codons and find the correct amino acid using the Codon Chart.
4. Write in correct tRNA anticodon on the tRNA molecule.
5. Answer the questions about the process of protein synthesis.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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DNA

mRNA

tRNA

Amino Acid

A T G G T A G C T A A C T A A

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A T G G A A T T G C T C T A G

DNA

mRNA

tRNA

Amino Acid

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**Analysis Questions:** Circle the correct word or phrase that best completes the following statements

1. mRNA is synthesized in *transcription / translation*.
2. mRNA has *codons / anticodons*.
3. A codon has *1 / 3* nucleotides that code for *1 / 3* amino acid.
4. tRNA brings amino acids to the *nucleus / ribosome*.
5. A polypeptide is a sequence of *proteins / amino acids* that are held together by *peptide bonds / hydrogen bonds*.
6. tRNA has *codons / anticodons*.
7. tRNA transfers amino acids during *transcription / translation*.
8. Ribosomes are the site where *transcription / translation* takes place.
9. Transcription occurs in the *nucleus / ribosome*.
10. Translation occurs in the *nucleus / ribosome*. **How does a cell interpret DNA?**

**Procedure:**

1. A certain gene has the following sequence of nucleotides:

**GAC AAG TCC ACA ATC**

Write this sequence in the space below direction #4.

1. From left to right, write the sequence of the mRNA molecule transcribed from this gene.
2. Using your Genetic Code Chart, read the mRNA codons from left to right and write the amino acid sequence of the protein.
3. Repeat step 3 reading the codons from right to left.

**Analyze and Conclude:**

1. Why did steps 3 and 4 produce different proteins?
2. Do cells usually decode nucleotides in one direction only or in either direction?

Biology I Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Creative Project: Central Dogma Explanation Period: \_\_\_\_ Date: \_\_\_/\_\_\_/\_\_\_

**Objective 4:** Explain how DNA and RNA code for proteins and determine traits.

**Procedure:**

You know that the central dogma of molecular biology explains how DNA is used to ultimately create proteins. It is now your task to create an explanation for each step of the diagram shown below. A list of terms you **must use** in your writing is also included below. Each word, used correctly, is worth 2 points.

**DNA**

**mRNA**

**Proteins**

**Transcription**

**Translation**

**Replication**

**Vocabulary Terms:**

* Adenine
* Amino Acid
* Anticodon
* Chargaff’s rules
* Codon
* Cytoplasm
* Cytosine
* DNA
* DNA Ligase
* DNA Polymerase
* Double-stranded
* Enzyme
* Exon
* Guanine
* Helicase
* Hydrogen Bond
* Intron
* Mutation
* mRNA
* Nitrogen bases
* Nucleotide
* Nucleus
* Peptide Bond
* Polypeptide
* Protein
* Replication
* Ribosome
* RNA Polymerase
* rRNA
* Phosphate
* Semiconservative
* Single-stranded
* Thymine
* Topoisomerase
* Transcription
* Transcription factors
* Translation
* tRNA
* Helix
* Uracil

Teacher Comments:

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80